Worksheet 3 Binary arithmetic

Task 1

Carry out the following binary sums showing your working out:

a) $101_2 + 111_2$

	1	0	1
	1	1	1

b) $10110_2 + 10111_2$

	1	0	1	1	0
	1	0	1	1	1

c) $11_2 + 100001_2 + 101_2$

				1	1
1	0	0	0	0	1
			1	0	1

d) $10101_2 + 111011_2 + 1001_2$

Show how the following values can be stored as binary bytes within a computer system and determine the answer that would be calculated and stored:

e) $12_{10} + 13_{10}$

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**

f) $174_{10} + 255_{10}$

g) $19_{10} + 66_{10} + 74_{10}$

Answer the following question:

h) A computer has been designed to work only in single bytes of data. Describe the problem that will be encountered when carrying out the sum $01111001_2 + 11111001_2$ if the answer is only allocated one byte of storage.

Task 2 Binary subtraction

Convert these decimal values into two's complement binary bytes:

a) -50_{10}

b) -120_{10}

c) 127_{10}

d) -128_{10}

e) Show that -50_{10} gives the same result as in (a) above using the following alternative method:

Assume the left-most bit represents -128. Start at -128 and then add the remaining values:

-128	64	32	16	8	4	2	1

Carry out the following calculations in two's complement binary bytes:

f) $-50_{10} - 30_{10}$ *or* $-50_{10} + -30_{10}$

1	1	0	0	1	1	1	0
1	1	1	0	0	0	1	0

g) $-66_{10} + 34_{10}$

h) $-88_{10} - 12_{10}$

i) $22_{10} - -14_{10}$

Task 3 Fixed point binary

Convert these decimal values into a fixed-point binary byte where the first 4 bits represent the whole number part and the the last 4 bits represent the fractional part:

a) 8.5_{10}

b) 14.25_{10}

c) 0.125_{10}

d) 5.5625_{10}

e) 1.9375_{10}

f) 0.0625_{10}

Convert these fixed-point binary bytes to decimal where the first 3 bits represent the whole number part and the the last 5 bits represent the fractional part:

g) 10101010_2

h) 10111011_2

i) 00111011_2

j) 11111000_2

k) 00011111_2

l) 11111111_2